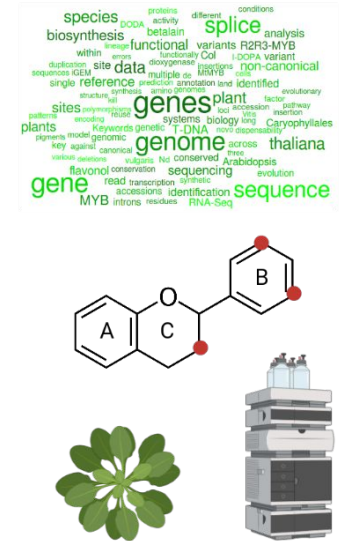
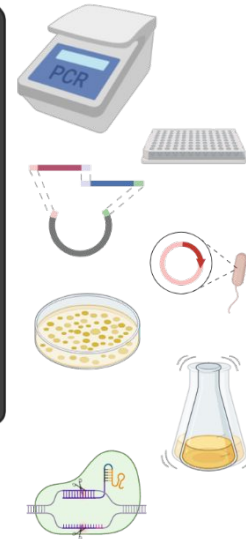
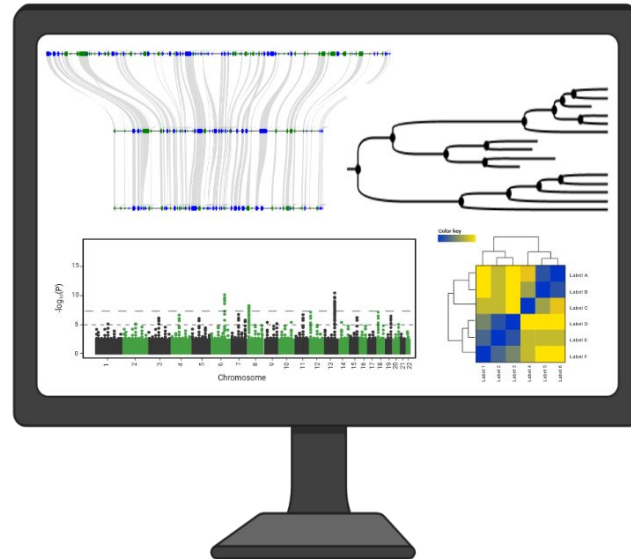
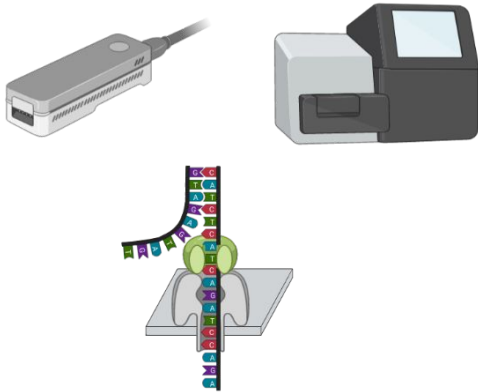




Technische
Universität
Braunschweig



Plant Biotechnology
and Bioinformatics

Python - Getting started

Prof. Dr. Boas Pucker (Plant Biotechnology and Bioinformatics)

Availability of slides

- All materials are freely available (CC BY) - after the lectures:
 - StudIP: 'Python for Life Scientists'
 - GitHub: <https://github.com/bpucker/teaching>
- Questions: Feel free to ask at any time
- Feedback, comments, or questions: [b.pucker\[a\]tu-bs.de](mailto:b.pucker[a]tu-bs.de)

My figures and content can be re-used in accordance with CC BY 4.0, but this might not apply to all images/logos. Some figure were constructed using bioRender.com.

How to learn Python?

- Look at the slides, try to understand, ask questions
- Do the exercises
- Practice
- Practice
- Practice
- Repeat the exercises at home
- All skills for the exercises are provided in course. Avoid using online searches.

Artificial intelligence

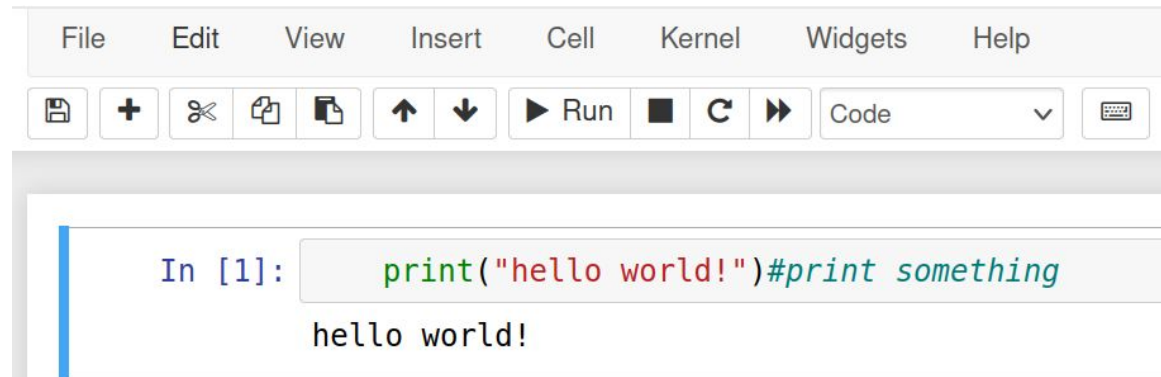
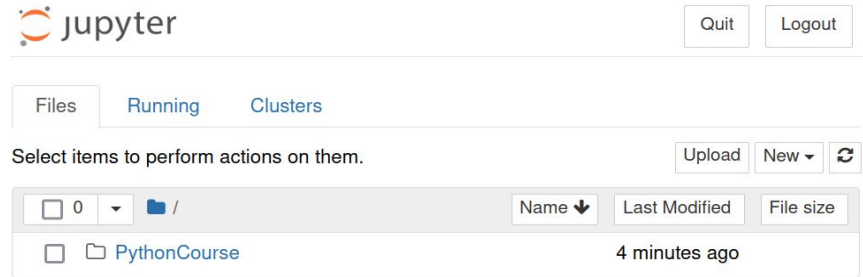
- Artificial intelligence (AI) is able to write Python code
- Quality of the code depends on quality of your prompts
- Basic understanding of Python is necessary to use AI effectively
- Do not use AI support for exercises of first 6 parts
- Use AI for the individual projects

Installing Jupyter Notebook

- Linux:
 - `$ sudo apt update`
 - `$ sudo apt install python3-pip python3-dev`
 - `$ mkdir python_course`
 - `$ cd python_course`
 - `$ virtualenv python_course`
 - `$ source python_course/bin/activate`
 - `$ pip install jupyter`
 - `$ jupyter notebook`
- Windows:
 - 1) Install Anaconda
(<https://www.geeksforgeeks.org/how-to-install-anaconda-on-windows/>)
 - 2) Install Python3 through Anaconda
 - 3) Install Jupyter through Anaconda
(<https://www.geeksforgeeks.org/how-to-install-jupyter-notebook-in-windows/>)
- Mac:
 - See instructions above
- ChromeOS:
 - JupyterLab (online): <https://jupyter.org/>

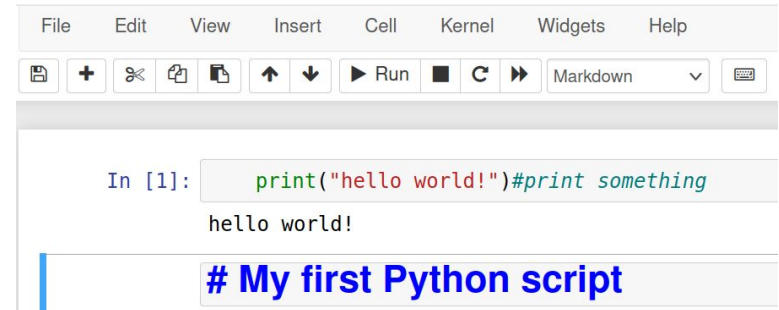
Starting Jupyter Notebook

- Start Jupyter Notebook
- Create a new file:
 - 'New'
 - Python3 ipykernel
 - Change name
- Python code is written and executed in Jupyter Notebook

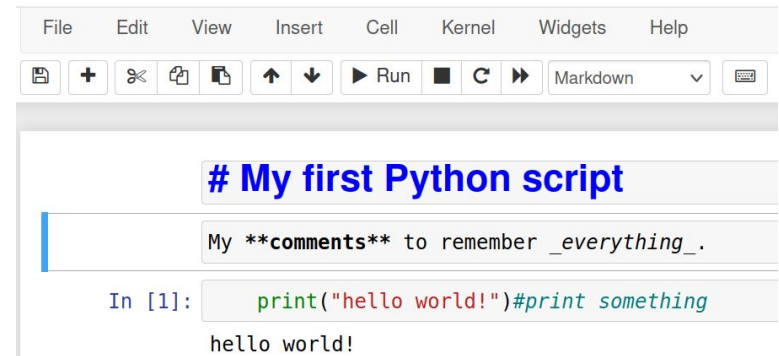


Adding elements to a Jupyter Notebook

- Code: you know this already
- Header: structure your work/documentation
- Markdown: comments with specific formatting



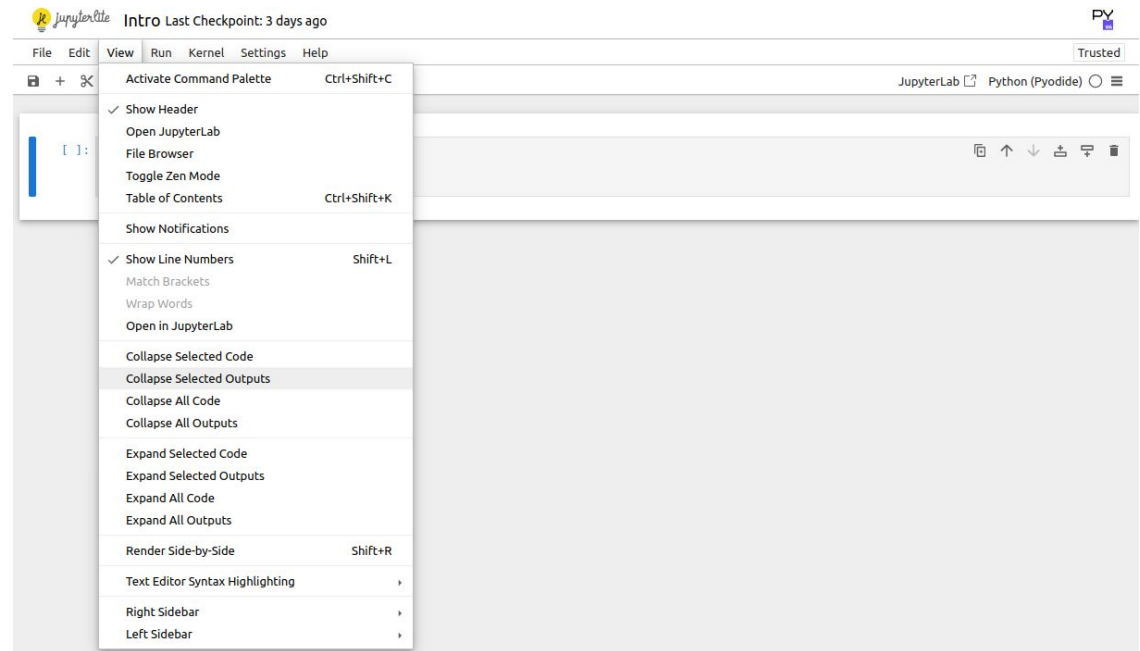
The screenshot shows a Jupyter Notebook interface with a menu bar (File, Edit, View, Insert, Cell, Kernel, Widgets, Help) and a toolbar with icons for saving, adding, deleting, copying, pasting, and navigating between cells. Below the toolbar, there are two cells. The first cell is a code cell containing the following text: `In [1]: print("hello world!")#print something` followed by the output `hello world!`. The second cell is a header cell containing the text `# My first Python script` in a blue font.



The screenshot shows a Jupyter Notebook interface with a menu bar (File, Edit, View, Insert, Cell, Kernel, Widgets, Help) and a toolbar with icons for saving, adding, deleting, copying, pasting, and navigating between cells. Below the toolbar, there are two cells. The first cell is a header cell containing the text `# My first Python script` in a blue font. The second cell is a code cell containing the following text: `In [1]: print("hello world!")#print something` followed by the output `hello world!`. Additionally, there is a text cell above the code cell containing the text `My **comments** to remember _everything_.`

Displaying line numbers

- CTRL+M+L
- CTRL+M ... + L
- CTRL + SHIFT + P (Mac)



Simple commands & variable types

- `print()` allows you to show the results of calculations in the terminal
- Different types of variables can be stored in a list
- Different types of number (int or float)

```
print("test") #print
my_list = ["1", "2", "3", 4, 5, 6] #list
my_int = 1 #int
my_float = float(3.1) #float
my_string = str(my_int) #string
```

Comments and structure

- Two ways to add comments:
- '#' rest of the line is comment and ignored by Python
- Triple quotation marks allow comments over multiple lines
- Use ASCII characters only (**no** ä, ö, ü, ß, ...)
- Empty lines are ignored by Python (use space to structure code)

Assignment and comparison

- '=' used to assign value to variable
- '==' compares two values/variables
- Variable names may contain characters, underline, and numbers (not at the start)
- Multiple assignments are possible

```
a, b = 'test1', 'test2'
```

```
a, b, c = 'test1', 'test2', ['not an empty list']
```

```
In [4]: a = 'hello world!'
        print(a)
```

hello world!

```
In [5]: b = 'test'
        c = 'test'
        a == b
```

Out[5]: False

```
In [6]: b == c
```

Out[6]: True

Variable type: string

- a, b, c are strings ('str')
- Python allows to check the variable type:
 - `type(a)`
- Almost all variable types can be converted to string:
 - `str(<VARIABLE>)`

Variable types: integer & float

- Two variable types for numbers
 - Integer = complete number (example: 3)
 - Float = decimal number (example: 3.1415926)
- Important: '.' NOT ',' separates numbers in float
- Some strings can be converted to integer/float
 - `My_int = int('3')`
 - `My_float = float('3.145926')`
- Check result via `type(<VARIABLE>)`

Python as calculator

- Numbers can be used for calculations
 - `a = 3`
 - `b = 2`
 - `print(a+b)`
 - `print(a*b)`
 - `print(a**b)`
 - `print(a/b)`
 - `print(a%b)` #modulo division
 - `print(a<b)`
 - `print(a!=b)`
- How to calculate roots?
- Interested in more complex math? (NumPy, SciPy)

Variable type: list

- List can contain elements of different types (e.g. strings)
- Elements can be accessed via index
- Index is given in square brackets after the list name:
- Matching your expectation?

```
my_list = [ "one", "two", "three" ]  
print( my_list[1] )
```

Indices in Python

- Python starts counting at 0!!!

```
my_list = ["one", "two", "three"]  
#           0       1       2
```

- Lists can be concatenated

```
new_list = my_list + ["four", "five", "six", "seven"]  
#new_list = ["one", "two", "three", "four", "five", "six", "seven"]  
#           0       1       2       3       4       5       6
```

- Print subset of list

```
print(new_list[3:])  
print(new_list[:3])  
print(new_list[3:5])
```

- Two indices: index1=first element to include; index2=first element following the selection

Indices in Python II

- Strings have indexes as well
- -1 points to the last element of a string/list
- -5 points to the 5th element from the end of a string/list

```
a = 'hello world test string!'
print(a[1:])
print(a[5:10])
print(a[:-1])
print(a[-5:-1])
```

Variable type: boolean (True/False)

- Already used for comparison:

```
print(1==1)
print(1>1)
print(1==True)
print(True+True)
print(True+False)
```

- Boolean variables can be used for calculations (like numbers)
- Most of the time used only for internal calculations

Brackets

- Two important types of brackets
 - '[' to generate lists and to access elements via index
 - '(' to transfer arguments to functions

```
a = []  
b = "test"  
print(b[1])
```

- What are functions?
 - Examples:

```
x = 3.145  
str(x)  
int(x)  
float(x)
```

Exercises - Part1a

- 1.1) Save 3,14159265359 in a variable of type float!
- 1.2) Convert variable from float to integer!
- 1.3) Convert variable back! What happens?
- 1.4) Convert variable to type string!
- 1.5) Save 'Python' in a string variable!
- 1.6) Convert variable type to float! What happens?

Connecting strings / lists

- Two lists can be concatenated by using the '+' operator

```
my_list1 = ["one", "two"]
my_list2 = ["3", "4"]
merged_list = my_list1 + my_list2
print(merged_list)
```

```
['one', 'two', '3', '4']
```

- Two strings can be concatenated by using the '+' operator

```
my_string1 = "hello"
my_string2 = "user"
merged_string = my_string1 + " " + my_string2
print(merged_string)
```

```
hello user
```

- Mixing different variable types does not work!

Adding content to lists - append()

- Individual elements can be added to lists in a more efficient way:

```
THE_list = ["1", "2", "3"]  
THE_list.append("4")  
print(THE_list)
```

```
['1', '2', '3', '4']
```

Exercises - Part1b

- 1.7) Build a sentence based on individual strings!
- 1.8) Find the most efficient way to build this string:
“hi, user!hi, user!hi, user!hi, user!hi, user!hi, user!hi, user!hi, user!hi, user!”

Time for questions!